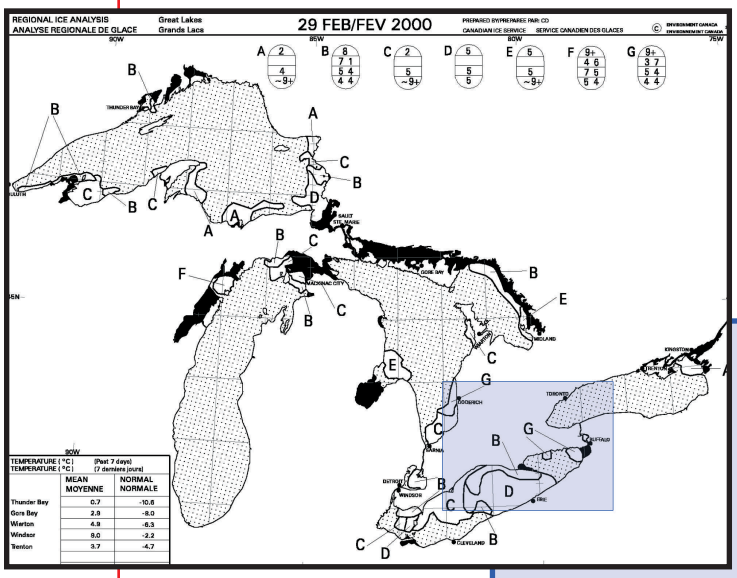
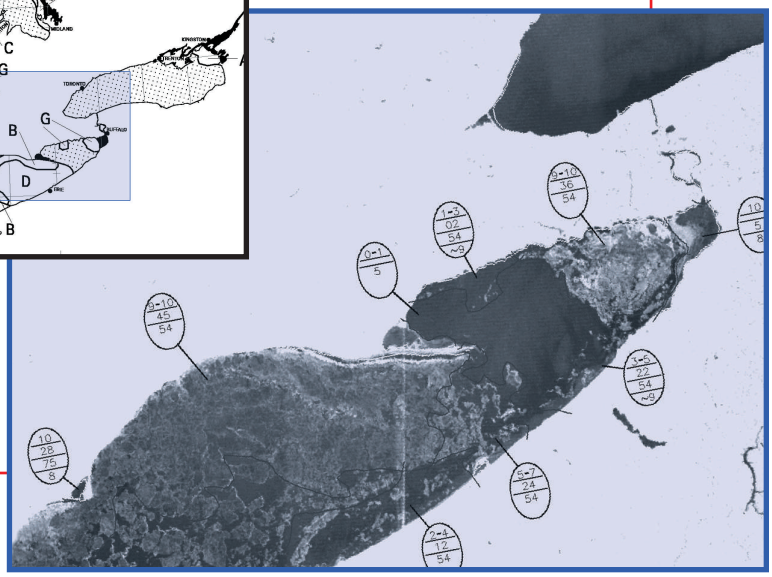
International Niagara Board of Control

Ninety Fourth Semi-Annual Progress Report to the International Joint Commission





Covering the Period September 15, 1999 through February 29, 2000

TABLE OF CONTENTS

COVER:	TOP	Video image of ice cover behind the ice boom.
	MIDDLE	Composite ice chart showing Great Lakes coverage.
	BOTTOM	Annotated RADARSAT image of ice on central and eastern Lake Erie.

TABLES **PAGE**

FIGURES

ENCLOSURES

INTERNET SITES

International Niagara Board of Control	http://huron.lre.usace.army.mil/ijc/niagara.html
International Joint Commission	http://www.ijc.org/
Lake Erie-Niagara River Ice Boom	http://www.iceboom.nypa.gov

INTERNATIONAL NIAGARA BOARD OF CONTROL

Cincinnati, Ohio
Burlington, Ontario

February 29, 2000

International Joint Commission
Washington, D. C.
Ottawa, Ontario

Commissioners:

1. GENERAL

The International Niagara Board of Control (Board) submits its Ninety Fourth Semi-Annual Progress Report, covering the period September 15, 1999 through February 29, 2000.

2. ITEMS OF INTEREST

For the months of September 1999 through February 2000, the level of Lake Erie remained below its long-term average. Precipitation on the Lake Erie basin during this period was below average. In addition, warmer than normal fall and early winter weather slowed formation of an ice cover and contributed to generally higher than average evaporation from the lake. Lakes Michigan and Huron continued to experience below average precipitation, and remained below their long-term average levels during this period. This resulted in lower than average inflows to Lake Erie.

The Power Entities (Ontario Power Generation Inc. (OPG) and the New York Power Authority (NYPA)) complied with the Board's 1993 Directive for regulation of Chippawa-Grass Island Pool water levels throughout the reporting period. A major long-term program to maintain and repair the decks above the gates of the control structure has been completed.

Discharge measurements were made in the Niagara River in the vicinity of the International Railway Bridge in November, 1999.

OPG has deferred making a decision on the Beck Diversion Project at Niagara Falls at this time. While the project has been shown to be environmentally sound, OPG has decided that it would be prudent to gain further insight into the operation of the new competitive Ontario electricity market before committing to a project of this magnitude.

OPG's Ontario Power Generating Station (OPGS), located on the Canadian side of the Maid-of-the-Mist Pool, was retired from service on November 26, 1999.

Installation of the Lake Erie - Niagara River ice boom spans began on December 19 and was completed on December 29, 1999. The October 1999 change in the Commission's Order of Approval providing for installation to begin on December 16 was exercised. This change made it much easier to plan the installation and reduce safety risks.

An annual test of the New York Power Authority's *Flood Warning Notification Plan in the Event of Ice-Affected Flooding on the Upper Niagara River* was held on January 30, 2000 to ensure that personnel have an adequate understanding of the procedures to be followed.

The Buffalo and Fort Erie Public Bridge Authority received a Supplementary Order to the IJC's April 30, 1999 Order of Approval for construction of a second bridge adjacent to the existing Peace Bridge which links Fort Erie, Ontario and Buffalo, New York. The Supplementary Order

extends the time frame for construction of the project by one year. Local issues regarding the new bridge design and the review process have arisen that are delaying the start of construction.

3. LAKE LEVELS

All elevations in this report are referenced to International Great Lakes Datum 1985. The values are expressed in metric units, with approximate English units (in parentheses) for information purposes only. The monthly lake level data are based on a network of four gages to better represent the average level of the lake. Recorded water level and precipitation data for the period September 1999 through February 2000 and departures from long-term averages are shown in Tables 1 and 2 and depicted graphically on Figures 1 and 2.

During the months of September 1999 through February 2000, the level of Lake Erie remained below its long-term average. The lake level followed its usual rate of seasonal decline from September into December, but dropped more than usual in January and February. The lake was about 11 centimetres (4 inches) below average from September through December. When the lake reached its lowest level of the season, 173.76 metres (570.08 feet), in February, it was 23 centimetres (9 inches) below the February long-term average.

The Lake Erie basin received approximately 35 centimetres (14 inches) of precipitation during the period September 1999 through February 2000. The period of record (1900–1995) average over this six-month period is 40.2 centimetres (15.8 inches). The departure from average over the six-month period was -13 %.

Water supplied to Lake Erie from its local drainage basin was generally below average for the period September 1999 through February 2000, as can be seen in Figure 3. Precipitation is just one of the factors that affects the supply of water to the lake, and ultimately its water level. Warmer than usual weather in late fall and early winter slowed formation of an ice cover on Lake

Erie. This combined with warm water temperatures and contributed to higher than average evaporation from the lake in December and January. This is reflected in the low net local supply of water to the lake during these two months, even though precipitation in December was above average. Below average precipitation in February combined with unseasonably warm temperatures, which melted snow and increased runoff, resulted in near normal supplies of water to the lake that month. This kept Lake Erie levels from falling even further in February.

Lakes Michigan and Huron continued to experience below average precipitation, and remained below their long-term average levels during this period. This has resulted in lower than average inflows to Lake Erie from the upstream lakes. Inflows from the upper lakes for the six-month period September 1999 through February 2000, averaged 4910 cubic metres per second (m^3/sec) (173,400 cubic feet per second (cfs)), while the corresponding period of record (1900–1989) average is 5,180 m^3/sec (182,900 cfs). This represents a deviation of -5 %.

The lower than average inflows from upstream and below average supplies of water from its local drainage basin have combined to keep the level of Lake Erie below average during the reporting period. The impact on flows into the Niagara River of lower than average Lake Erie levels is graphically depicted in Figure 4 and summarized in Section 6.

There is little or no snow remaining on much of the Great Lakes basin to feed the normal spring rise in lake levels. The March 2000 water level forecast indicates that, while the level of Lake Erie is expected to begin its seasonal rise in March and continue to rise into early summer, it will remain well below its long-term average during the next six months. At its peak for the year, the lake could be about 24 centimetres (9 inches) lower than the peak of last year.

TABLE 1 - MONTHLY AVERAGE LAKE ERIE WATER LEVELS

(Based on a network of 4 water level gages)

International Great Lakes Datum (1985)

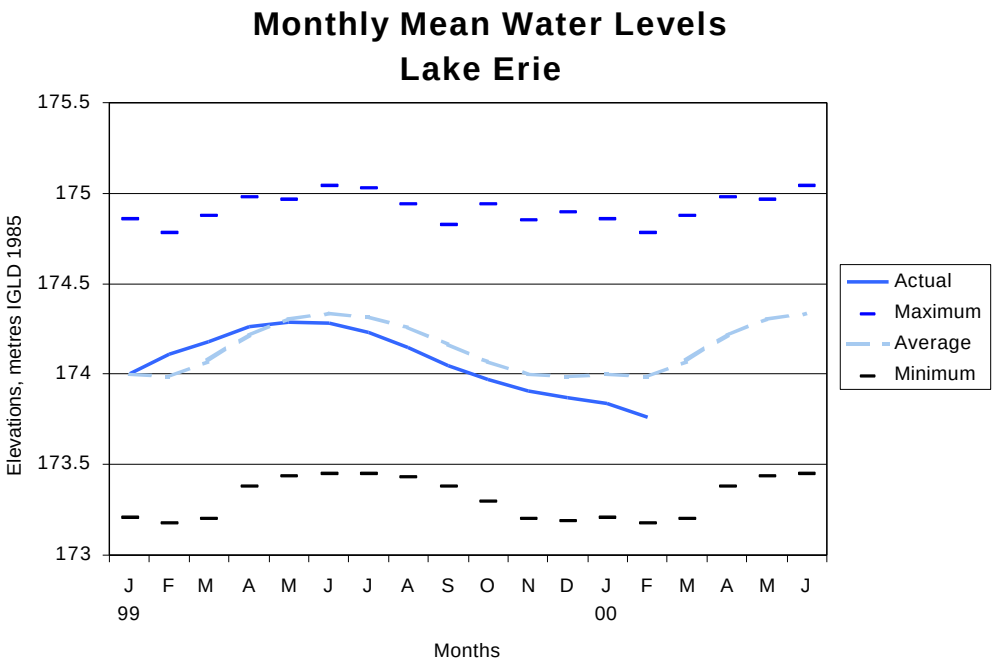
	Metres			Feet		
Month	Recorded* 1999-2000	Average 1918-98	Departure	Recorded* 1999-2000	Average 1918-98	Departure
September 99	174.05	174.17	-0.12	571.03	571.42	-0.39
October	173.97	174.07	-0.10	570.77	571.10	-0.33
November	173.91	174.00	-0.09	570.57	570.87	-0.30
December	173.87	173.99	-0.12	570.44	570.83	-0.39
January 00	173.84	174.00	-0.16	570.34	570.87	-0.53
February	173.76	173.99	-0.23	570.08	570.83	-0.75

*Provisional

TABLE 2 - MONTHLY AVERAGE PRECIPITATION ON THE LAKE ERIE BASIN

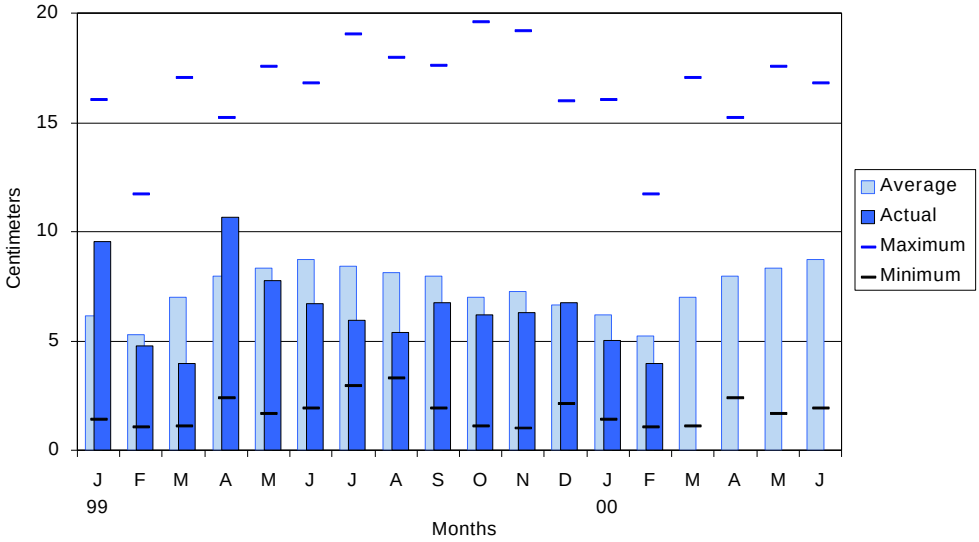
	Centimetres			Inches			
Month	Recorded* 1999-2000	Average 1900-95	Departure	Recorded* 1999-2000	Average 1900-95	Departure	Departure in percent
September 99	6.76	7.95	-1.19	2.66	3.13	-0.47	-15
October	6.20	6.98	-0.78	2.44	2.75	-0.31	-11
November	6.27	7.24	-0.97	2.47	2.85	-0.38	-13
December	6.76	6.63	+0.13	2.66	2.61	+0.05	+ 2
January 00	5.00	6.20	-1.20	1.97	2.44	-0.47	-19
February	3.94	5.23	-1.29	1.55	2.06	-0.51	-25

*Provisional



Period of Record 1918-1998.
Values for 2000 are provisional.

Figure 1



Period of Record 1900-1995.
Values for 1999 and 2000 are provisional.

Figure 2

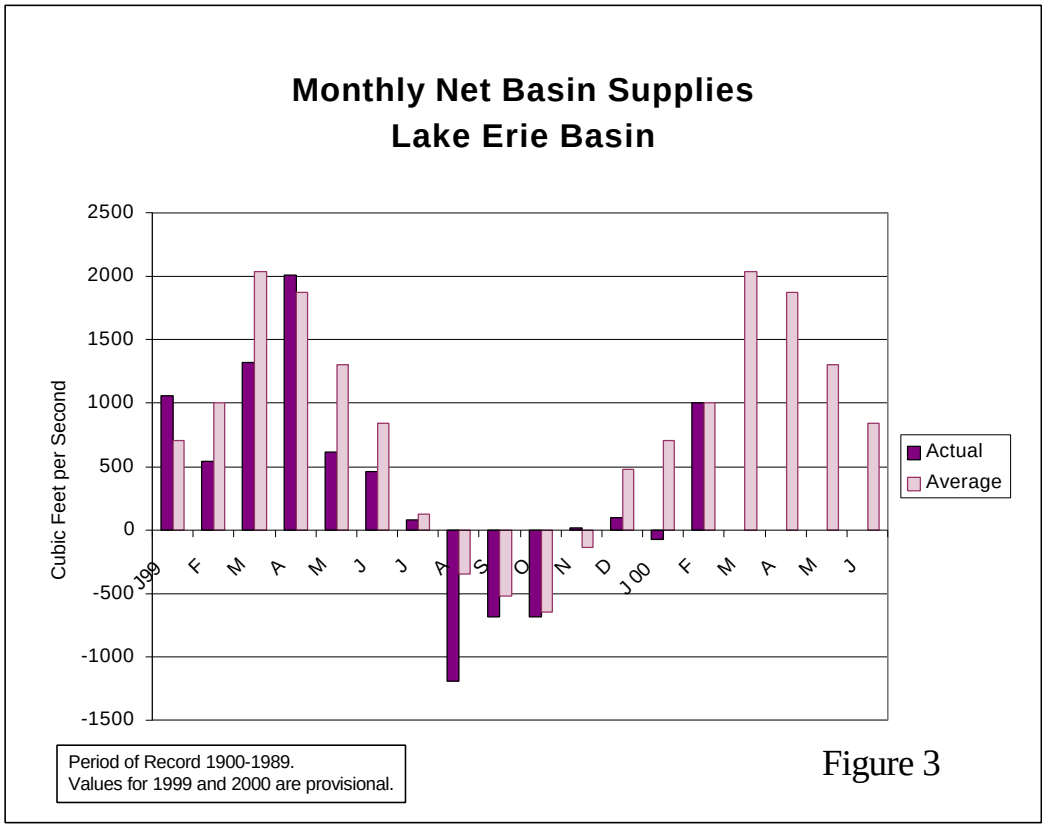


Figure 3

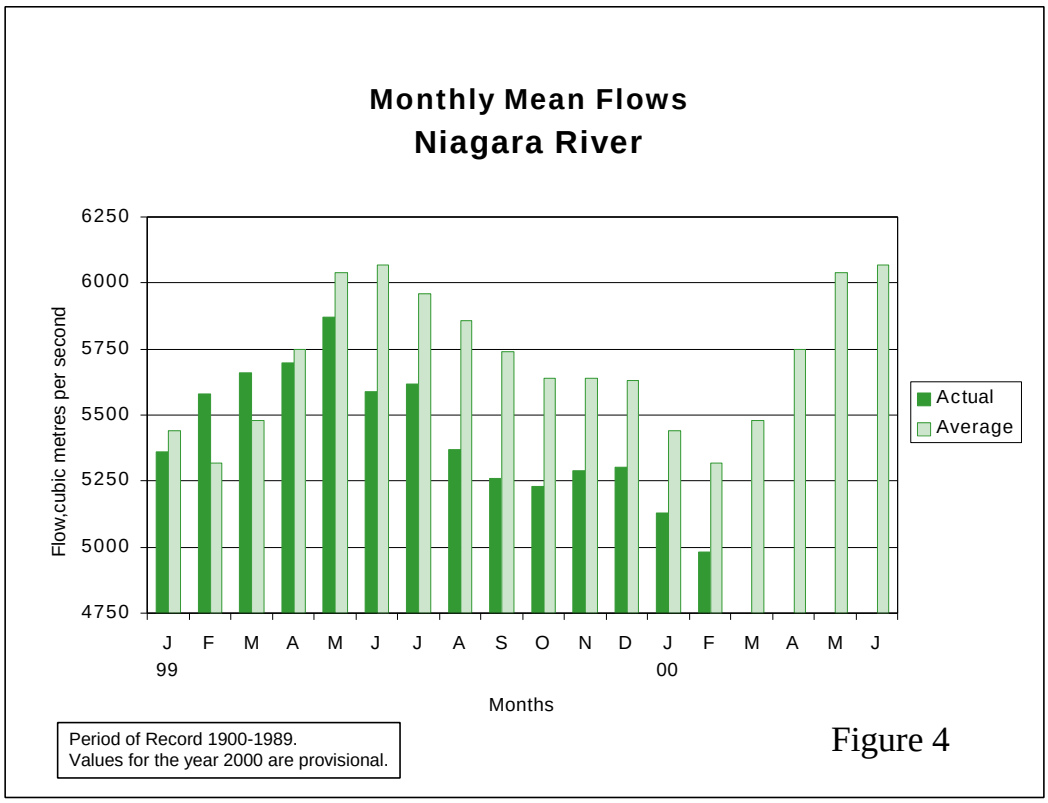


Figure 4

4. OPERATION AND MAINTENANCE OF THE CHIPPAWA-GRASS ISLAND POOL CONTROL STRUCTURE

The water level in the Chippawa-Grass Island Pool is regulated in accordance with the Board's 1993 Directive. The Directive requires that the Power Entities (Ontario Power Generation Inc. (OPG) and the New York Power Authority (NYPA)) operate the Chippawa-Grass Island Pool (Pool) control structure to ensure the maintenance of an operational long-term average pool level of 171.16 metres (561.55 feet) to ameliorate adverse high or low water levels in the pool. The Directive also establishes certain tolerances for the pool's level as measured at the Material Dock gage. The Power Entities complied with the Board's Directive throughout the reporting period.

The accumulated deviation of the pool's level from March 1, 1973 through February 29, 2000 was 0.74 metre-month (2.43 foot-months) above the long-term average elevation. The maximum permissible accumulated deviation is 0.91 metre-month (3.00 foot-months).

Tolerances for regulation of the Chippawa-Grass Island Pool levels were suspended for 2 days in December 1999 due to abnormally low river flows and for 7 days in January and 12 days in February to assist control structure operators with ice management in the Pool.

Recorded daily Material Dock water levels covering the period March 1999 through February 2000 are shown in Enclosure 1. The location of the water level gages on the Niagara River are shown in Enclosure 2.

The Power Entities have completed a major long-term program to maintain and repair the control structure. In 1999, the decks over gates 10 and 11 were lifted for about three months each to allow for removal of deteriorated concrete and application of new concrete and seals to the beam seats and ends of the pre-cast beams of the decks. The work was finished in the fall. Similar repairs, required on the decks above 11 of the original 13 gates have been completed over the period

since 1982. The decks above the remaining 5 gates, 14 through 18, are a different design not requiring these repairs.

5. FLOWS OVER NIAGARA FALLS

During the tourist season daylight hours, the required minimum Niagara Falls flow is 2832 m^3/s (100,000 cfs). At night and during the winter months, the required minimum Falls flow is 1416 m^3/s (50,000 cfs). The operation of the Chippawa-Grass Island Pool control structure, in conjunction with power diversion operations, ensures sufficient flow over the Falls to meet the requirements of the Niagara Treaty of 1950.

Falls flows met or exceeded minimum Treaty requirements at all times during the reporting period. The recorded daily flows over Niagara Falls, covering the period September 1999 through February 2000, are shown in Enclosure 3.

6. DIVERSIONS AND FLOW AT QUEENSTON

Diversion of water from the Niagara River for power purposes is governed by the terms and conditions of the 1950 Niagara Treaty. The Treaty prohibits the diversion of Niagara River water that would reduce the flow over Niagara Falls to below the amounts specified for scenic purposes.

The high head hydro power plants, OPG's Sir Adam Beck 1 and 2 in Canada and NYPA's Niagara Power Project in the United States, withdraw water from the Chippawa-Grass Island Pool and discharge it into the lower Niagara River at Queenston, Ontario and Lewiston, New York, respectively. During the period September 1999 through February 2000, diversion flows for the Sir

Adam Beck 1 and 2 plants averaged a total of 1632 m^3/s (57,630 cfs) and those by the Niagara Power Project averaged 1787 m^3/s (63,110 cfs).

The low head hydro power plants, Canadian Niagara Power's (CNP) Rankin Plant and OPG's Ontario Power Generating Station (OPGS), divert water from the Cascades, just upstream of the Horseshoe Falls, and discharge it into the Maid-of-the-Mist Pool. Since the operating efficiencies of these two older plants are much lower than those of the high head plants, water that is available for power generation is normally dispatched on a priority basis to the high head plants, with the excess being directed to the low head installations. During the period September 1999 through February 2000, diversion flow for the CNP Rankin plant averaged 39 m^3/s (1,380 cfs). The OPGS ceased generating on November 26, 1999 and was retired from service. Diversion flow for the OPGS plant averaged 11 m^3/s (390 cfs) for the period September through November 26, 1999. Records of Niagara River diversions for power generation covering the period September 1999 through February 2000 are shown in Enclosure 4.

The average flow from Lake Erie to the Welland Canal for the period September 1999 through February 2000 was 175 m^3/s (6,180 cfs). Diversion from the canal to OPG's DeCew Generating Stations averaged 127 m^3/s (4,480 cfs) for the same period.

The monthly average Niagara River flows at Queenston, Ontario for the period September 1999 through February 2000, were:

September	5255 m^3/s	(185,580 cfs)
October	5221 m^3/s	(184,380 cfs)
November	5340 m^3/s	(188,580 cfs)
December	5350 m^3/s	(188,930 cfs)
January	5174 m^3/s	(182,720 cfs)
February	4980 m^3/s	(175,870 cfs)

During this period, the flow averaged 5220 m^3/s (184,340 cfs). During the period September 1998 through February 1999 the average flow was 5785 m^3/s (204,280 cfs) and the monthly averages ranged between 5393 m^3/s (190,450 cfs) and 6262 m^3/s (221,140 cfs).

7. GAGING STATIONS

The Niagara River gages used to monitor the Chippawa-Grass Island Pool levels and flows over Niagara Falls are Slater's Point, Material Dock, American Falls and Ashland Avenue gages (see Enclosure 2). All gages required for the operation of the Chippawa-Grass Island Pool control structure were in operation during the reporting period.

Both the U. S. National Oceanic and Atmospheric Administration and the Power Entities operate water level gages at the Ashland Avenue location. Subject to continuing comparison checks of the water level data from both instruments by the International Niagara Committee (INC), the Power Entities' gage is used for officially recording water levels used in determining the flows over Niagara Falls. Comparison of water level readings from both gages showed that they were within acceptable INC tolerances throughout the reporting period.

NYPA is continuing its effort to assess possible measures that might be used to stabilize the riverbank near the Ashland Avenue gage. Under consideration are alternatives for conducting an underwater survey that is needed to complete an engineering feasibility study. From this study, preliminary designs, material requirements, the construction feasibility, and costs for several alternatives will be developed. After this preliminary evaluation of possible mitigating measures is completed, NYPA will meet with OPG to discuss the costs and benefits. Based on those discussions, a decision will be made about whether and when any remedial work should be undertaken to ensure the long-term operation of the gage.

Ontario Power Generation are investigating relocating and upgrading the Ontario Power Generating Station tailwater gage to increase its reliability during ice conditions. This gage is used as a back-up to the Ashland Avenue Gage during ice free conditions and as an indication of flow restriction in the Maid-of-the-Mist Pool caused by ice jamming/shifting.

8. FLOW MEASUREMENTS IN THE NIAGARA RIVER AND WELLAND SHIP CANAL

As part of a regular program to verify stage-discharge relationships used to determine Niagara River flows, measurements were conducted near the International Railway Bridge on November 23, 24 and 25, 1999. An Acoustic Doppler Current Profiler was used for all measurements, which were obtained through joint efforts of the United States Army Corps of Engineers and Environment Canada. A total of 99 measurements were taken. Preliminary review of these data indicates that the data are within field measurement tolerance. These measurements were made at the lowest flow range yet measured in this reach. Additional measurements will be made at this section in May 2000. This will aid in the continuing effort to derive revised stage-discharge relationships for the Buffalo and Fort Erie gauges.

Measurements will be made at the American Falls section in May, 2000 as part of a continuing program to verify gauge ratings used in water level management. A proposed schedule for these measurements, which will cover the period May 2 through 5, 2000, was forwarded to Ontario Power Generation and the New York Power Authority in December 1999. The Board requested the Power Entities co-operation in maintaining the water level in the Chippawa-Grass Island Pool (CGIP) steady during these May measurements at the American Falls Section.

9. **POWER PLANTS**

a) New York Power Authority

The upgrade of the Robert Moses Niagara Power Plant (RMNPP) Unit 3 began in November, 1999 with an anticipated returned to service in July, 2000. Index tests of Units 3 and 6 are tentatively scheduled to occur in September 2000. Unit 12 will be the next upgraded with the schedule calling for a November 2000 start with completion in June 2001.

NYPA anticipates that a report on the index tests of Units 1 and 10 will be completed and forwarded to the International Niagara Committee by July 2000.

In compliance with the U. S. Federal Energy Regulatory Commission's (FERC) requirements, the New York Power Authority has prepared and amended its Flood Warning Notification Plan in the Event of Ice-Affected Flooding on the Upper Niagara River. A completely reprinted copy of the most up-to-date Plan, dated December 1999, was issued by NYPA and redistributed to all participating alerting agencies. This is in accordance with the five-year cycle established by FERC. Several format and mapping enhancements were incorporated.

The annual test of the Plan was held on January 30, 2000. The purpose of the test is to ensure that personnel have an adequate understanding of the procedures to be followed. Operators and key personnel simulated the procedures to be followed and any actions required during a flooding event. The alerting agencies were notified to enhance the realism of the test.

b) Ontario Power Generation

To date, six units at the Sir Adam Beck II Generating Station have been rehabilitated (including runner replacement). Upgrade work started on Unit G20 in October, 1999, and is expected to continue until June, 2000.

A revised interim rating table, used to determine water usage, has been implemented as of July 27, 1999 with the concurrence of the International Niagara Committee's On-Site Representatives. This interim table has been prepared from the results of testing done on the first three units upgraded. Two of these units underwent full performance tests using the Gibson method while the third was index tested.

The upgrades and expansions by the Power Entities will not affect the regulation of the Chippawa-Grass Island Pool water levels as governed by the International Niagara Board of Control's Directive. In addition, they will not require any modifications to other rules or regulations (such as the 1950 Niagara Treaty) relating to the diversion of water for operation of the projects.

OPG's Ontario Power Generating Station, located on the Canadian side of the Maid-of-the-Mist Pool, ceased generation on November 26, 1999 and was retired from service. The decision to retire this plant early was made to expedite construction of the new casino project on the Murray Hill site near the plant. Underground cables carrying power from the OPGS must be removed from the property adjacent to the casino site before construction work can start. No decision has been made on the long term disposition or use of this property.

10. ICE CONDITIONS AND ICE BOOM OPERATIONS

In accordance with Condition (d) of the Commission's October 5, 1999 supplementary Order of Approval, installation of the Lake Erie-Niagara River Ice Boom's spans commenced on December 19, 1999. Installation may begin when the Lake Erie water temperature at Buffalo reaches 4 degrees Celsius (C) (39 degrees Fahrenheit (F)) or on December 16th, whichever occurs first.

Preparations for placement of the 22 spans began with positioning of floatation barrels on December 13 and 14. The strings of pontoons were removed from their summer storage area and placed inside the Buffalo Harbor breakwall over the following few days. Installation of 14 spans, extending from the Canadian shore, was accomplished on December 19. A further 2 spans were installed extending from the U. S. shore on December 20. Strong winds delayed further span placement for several days. Installation of the final 6 spans was completed on December 29.

The October 1999 change in the Commission's Order of Approval providing for installation to begin on December 16 was exercised. This change made it much easier to plan the installation and reduce safety risks. Installation governed by criterion (d) of the 1984 Order, would not have begun until December 27 at the earliest. The Lake Erie water temperature, as measured at the Buffalo water intake was 40^{o}F (4^{o}C) on December 26 and dropped to 36^{o}F (2^{o}C) on December 27.

Even though ice did not form on eastern Lake Erie until the middle of January, very little damage to the steel pontoons occurred from the open water conditions. Thus far, there have been no significant lake ice runs despite several winter storms with associated high winds from the southwest. The steel pontoon spans performed as intended, minimizing the amount of lake ice entering the Niagara River through increased resistance to ice overtopping.

Ice first began forming behind the boom around January 18. By the end of the month, much of the eastern basin had a thin cover of ice. A trailing span of pontoons, span "M", was observed on February 1st. Inspection revealed that the span cable had failed near one end. A short length of replacement cable was spliced in between the anchor tie plate and the span cable. This repair was completed on February 4.

Temperatures 5 to 6°C (9 to 11°F) above normal prevailed during the last half of February of Lake Erie. By the end of February, there was open water in the eastern end of the lake and along the southern coast.

11. PEACE BRIDGE

On April 30, 1999, the International Joint Commission issued an Order of Approval to the Buffalo and Fort Erie Public Bridge Authority for construction of a second span over the Niagara River between Buffalo, New York and Fort Erie, Ontario. Since then, local issues regarding the new bridge design and the review process have arisen that are delaying the start of construction. The Commission issued a Supplementary Order December 28, 1999 extending the time frame for construction by one year.

As part of the Order of Approval, it is required that water levels upstream and downstream of the bridge be monitored during construction and for at least 10 years after. This is to be done to verify that the completed project will have no effect on Lake Erie levels and outflows. On June 30, 1999, a gage was reinstalled by the Canadian Hydrographic Service, at the location of a previous Environment Canada gage, about 450 metres (1500 feet) downstream of the Peace Bridge on the Canadian side of the river. On the U.S. side of the river several new and existing gage locations downstream of the bridge were investigated. It was determined that the existing gage at Anderson Park on Squaw Island was well situated for the purpose of this monitoring. The gage, owned and operated by the U.S. Geological Survey, will be upgraded, with

the cooperation of the Public Bridge Authority, to provide redundant water level determination and real-time access to the data.

The Public Bridge Authority undertook a bathymetric survey enabling extension of the numerical model used for determining impact on flows and levels of the Peace Bridge expansion project. The expanded model will be useful in monitoring potential impact.

12. **STRAWBERRY ISLAND**

The New York State Department of Environmental Conservation has undertaken a further phase of restoration work on Strawberry Island, a small island located in the upper Niagara River between the International Railway Bridge and the southern tip of Grand Island, New York. This phase involves placement of breakwalls at the downstream portion of the existing island. Areas inside the breakwalls will be filled with material removed from the Buckhorn Marsh at the northern end of Grand Island.

Initially, construction of a low profile rock riprap berm with a centre core of sand, gravel and organic material was completed in December 1993. The river had broken through a narrow strip of beach along the southwestern (upstream) perimeter of the island. This berm stabilized the area formerly breached and the rough surface caused sand and gravel to accrete at the toe of the structure. Erosion control vegetation was subsequently planted.

The plan for this further restoration phase was reviewed by the Buffalo District of the U.S. Army Corps of Engineers. Recommendations to streamline the placement of the breakwalls (minimizing impact on streamflow) were made and incorporated. The width of the island will be increased by about 22 metres (72 feet). Breakwall construction will be in water depths of less than 79 centimetres (31 inches) in areas where portions of the island used to exist.

A concern could be that placement of material in the upper Niagara River in fast flowing, narrow portions of the river could affect upstream levels and flows extending into Lake Erie.

The location of Strawberry Island is in a broader, slower flowing area of the river where the majority of flow is deflected around the island. The breakwall designs have been re-aligned to be parallel to the river in the shallow waters at the downstream end of the island. The added material will replace that which has been lost through erosion and dredging.

The proponent has consulted with the U.S. Department of State and the Canadian Department of Foreign Affairs and International Trade regarding this undertaking in boundary waters.

The Board will continue to keep the Commission informed regarding this proposed phase for restoration of Strawberry Island.

13. MEETING WITH THE PUBLIC

In accordance with the Commission's requirements, the Board intends to hold an annual meeting with the public in the fall of 2000. The location and date will be determined later. The Board encourages Commission participation and will keep the Commission apprised of arrangements as they are developed.

14. MEMBERSHIP OF THE BOARD

The membership of the Board and its International Niagara Working Committee is unchanged.

15. ATTENDANCE AT BOARD MEETINGS

The Board met once during this reporting period on February 29, 2000 in Massena, New York. COL James Hougnon participated as alternate for BG Robert Griffin who was unable to attend. All other Board members were in attendance.

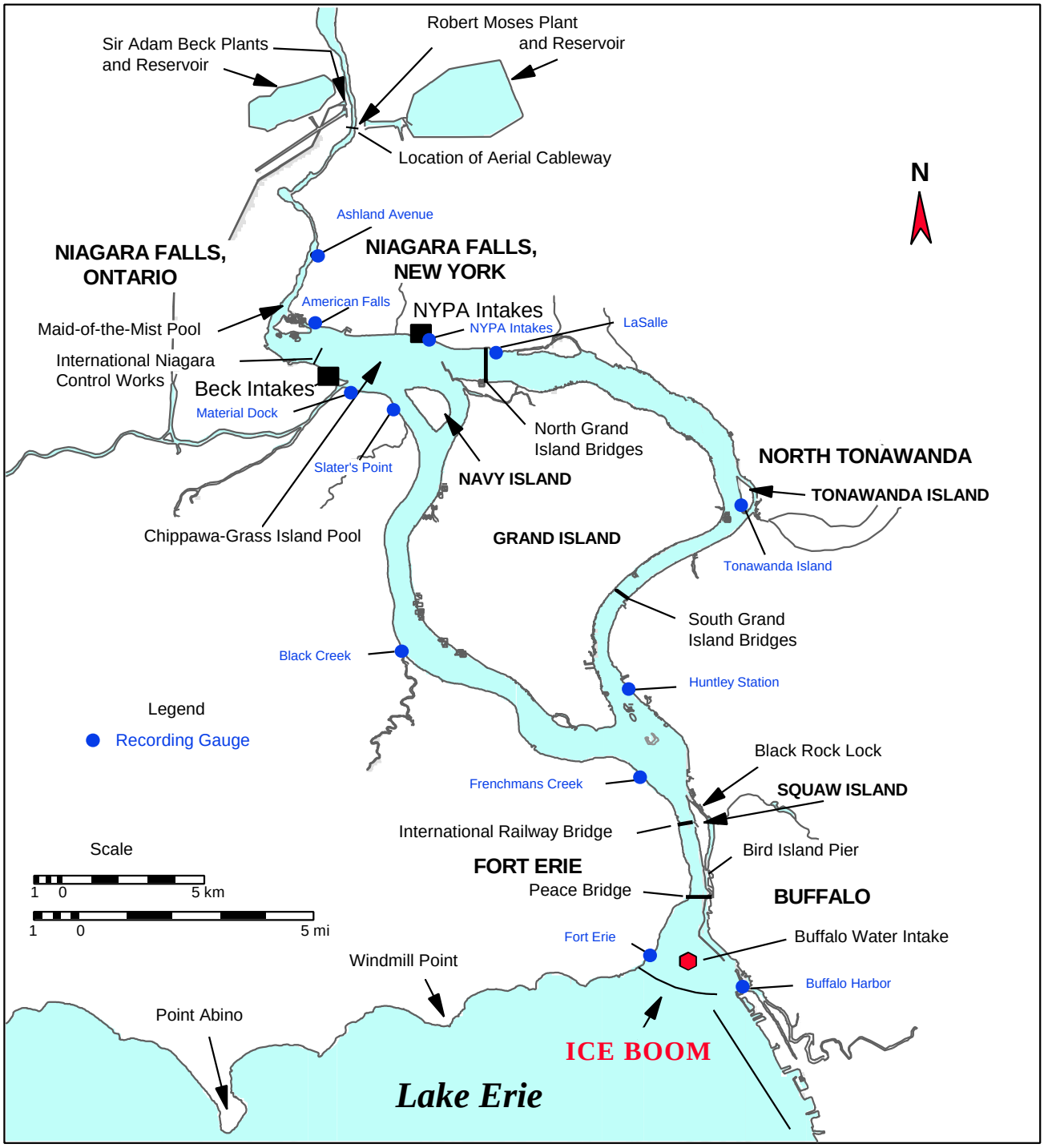
Respectfully Submitted,

BRIGADIER GENERAL ROBERT H. GRIFFIN
Chair, United States Section

DOUG CUTHBERT
Chair, Canadian Section

CONSTANTINE G. TJOUMAS
Member, United States Section

ROBERT B. CHANG
Member, Canadian Section



MAP OF UPPER NIAGARA RIVER

ENCLOSURE 2